

D. Corrugated Separator Plates

[0046] As described above, efficient operation of the plate reformer requires thorough contact of the gas streams with the catalytic walls. Redirecting the gas flow towards the catalytic wall enhances contact between the gas stream and the catalytic wall. This can be achieved by corrugating the separator plate. By forming alternating ridges and grooves in the separator plate, the effective heat and mass transfer coefficient can be increased in a manner similar to that achieved by placing an insert in the space between adjacent separator plates. **Figure 10** shows two specific embodiments of corrugated separator plates. **Figure 10A** shows a straight channel corrugation in which the ridges and grooves of the corrugations are formed to be straight from one end of the separator plate to the other end, essentially from inlet to outlet. This type of corrugated plate cannot be stacked with a similar straight channel corrugation since the corrugations would mesh but would be combined with a flat separator plate to form open channels with the corrugated structure separating the plates and keeping them spaced in a uniform fashion. In **Figure 10B**, the corrugation is in the form of a herringbone pattern with the ridges and grooves formed at an angle to the long sides of the separator plate and changing direction periodically to form a channel that essentially flows from inlet to outlet. This herringbone type of corrugation can be stacked with itself by flipping every second plate along the long axis so that the channels are not aligned and do not mesh. This would then form a flow path from the inlet to the outlet with the gas flow meandering through the channels.

[0047] Such straight and herringbone corrugated separator plates can be formed by stamping, with specially designed rollers or through a variety of forming techniques. The depth of corrugations is preferably sufficient to induce turbulence in the reaction mixture as it flows through the reaction channel. Typically, the height of the corrugation is equal to the total thickness of the transverse flow plate between

each separator plate so that the corrugated separator plates, when stacked with the transverse-flow plates, essentially fill the inter-plate voids between the separator plates and form a well defined reaction zone of defined geometry. Corrugation height is typically between about 0.01 to 0.5 inches and preferably between about 0.02 to 0.2 inches.

E. Thermal Conductivity of the Separator

[0048] Since the reaction heat for the endothermic and exothermic reactions is conducted across the separator, the thermal conductivity of this component is important. A typical thermal conductivity for the separator is in the range of between about 10 W/m-K to about 35 W/m-K. While a high thermal conductivity would be expected to be advantageous, it has been found that conductivity in this stated range is quite adequate to transfer the heat rapidly from the exothermic catalytic coating to the endothermic catalytic coating.

F. Transverse Flow Plates

[0049] The transverse-flow plate thickness defines the height of the reaction channel since it sets the separation between separator plates. The height of the reaction channel is determined by the desired flow velocity and the design of any flow redirecting devices contained in the reaction channel. Since a compact device is desirable, flow redirecting devices should be as thin as practical, with the reaction channel dimensions dependent upon the desired gas velocity. The reaction channel height is typically between about 0.01 and 0.5 inches, and preferably between about 0.02 and 0.25 inches. If the structure of the bicatalytic reactor includes a single transverse-flow plate separating two separator plates, then the distance between two adjacent separators is the preferred thickness of the transverse-flow plate. If the

design includes two transverse-flow plates between each pair of separator plates, then each transverse-flow plate will be half the distance between two adjacent separator plates.

G. The Reforming Process of the Invention

[0050] The reforming process of the invention may be used with a wide variety of fuels and a broad range of process conditions. A single fuel feedstock can be fed to the reforming and combustion zones, or different fuels can be used for reforming and combustion. Although normally gaseous hydrocarbons, e.g., methane, ethane, and propane, are highly desirable as a source of fuel for the process, most carbonaceous fuels capable of being vaporized at process temperatures discussed below are suitable. For instance, the fuels may be liquid or gaseous at room temperature and pressure. Examples include the low molecular weight aliphatic hydrocarbons mentioned above as well as butane, pentane, hexane, heptane, octane, gasoline, diesel fuel and kerosene; jet fuels; other middle distillates; heavier fuels (preferably hydro-treated to remove organo-sulfuric and organo-nitrogen compounds); oxygen-containing fuels such as alcohols, including methanol, ethanol, isopropanol, butanol, or the like; and ethers such as diethylether, ethyl phenyl ether, MTBE, etc. The process is also suitable to combust hydrogen gas, either pure or mixed with hydrocarbon and/or inert gases.

H. The Combustion Zone

[0051] The fuel is typically mixed into the combustion air in the amounts required in order to produce a mixture having an adiabatic combustion temperature preferably above 900°C, most preferably above 1000°C. Non-gaseous fuels should be at least partially vaporized before they contact the catalyst zone. The combustion